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POLICY SIMULATION OF THE INTERNATIONAL COFFEE ECONOMY.(U)
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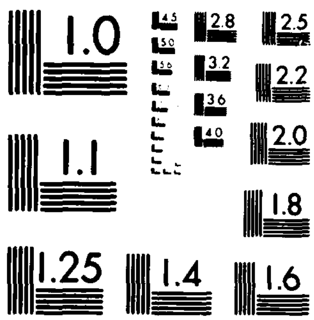

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POLICY SIMULATION OF THE INTERNATIONAL COFFEE ECONOMY: FINAL REPORT

by Walter C. Labys*

Summary

This final report describes the completed research of the coffee policy simulation project. It briefly reviews progress leading to the policy simulation stage, describes the policy simulation procedure itself and presents some simulation results. The report traces research activity that has taken place between August 12 and September 14, 1981, and consists of the following parts: model estimation and testing, model base forecasts, and policy simulation of quota levels. The theoretical specification adopted for the coffee model that provides the basis for the simulations is given in the initial project report: "Policy Simulation of the International Coffee Economy: Model Description."

Model Estimation and Testing

The estimated or empirical model that has been derived from the theoretical model specification is given in the second project report: "Policy Simulation of the International Coffee Economy: Interim Report." Missing from that report are the final variable adjustments to individual equations. These are listed below incomplete of the underlying statistics

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of parameter significance, goodness of fit, and autocorrelation. The list of variables employed in the model is given below in Table 1, and equation statistics may be found in Appendix 1.

EXPORTS BY COUNTRY AND REGION

```
BRAZIL:

EXBRAEQ: EQUATION
1>EXBRA=QBRA-CONBRA-(IEBRA-IEBRA\1)

AHBRAEQ: EQUATION
1>AHBRA= <281.225> + <0.559341>*AHBRA\1 + <20.6913>*PR1\7 &&
2> + <0.474394>*(AHBRA\1-(<281.225>+<0.559341>*AHBRA\2+<20.6913>* &&
3>PR1\8))
(AHBRAEQ HAS BEEN CORRECTED FOR FIRST-ORDER AUTOCORRELATION)

QBRAEQ: EQUATION
1>QBRA=AHBRA*YLDBRA

IEBRAEQ: EQUATION
1>IEBRA= <-17556.0> + <0.883839>*((IEBRA\1+QBRA)) + <4490.96>*DIBRA &&
2> + <0.408299>*(IEBRA\1-(<-17556.0>+<0.883839>*((IEBRA\2+QBRA\1)) &&
3>+<4490.96>*DIBRA\1))
(IEBRAEQ HAS BEEN CORRECTED FOR FIRST-ORDER AUTOCORRELATION)

YLDBRA, CONBRA = EXOGENOUS

COLOMBIA:

EXCOLEQ: EQUATION
1>EXCOL=QCOL-CONCOL-(IECOL-IECOL\1)

QCOLEQ: EQUATION
1>QCOL= <-1237.55> + <1.03342>*QCOL\1 + <11.1456>*PR1\1 &&
2> + <1437.51>*DCOL - <0.631282>*(QCOL\1-(<-1237.55>+<1.03342>* &&
3>QCOL\2+<11.1456>*PR1\2+<1437.51>*DCOL\1))
(QCOLEQ HAS BEEN CORRECTED FOR FIRST-ORDER AUTOCORRELATION)

CONCOL, IECOL = EXOGENOUS

OTHER SOUTH AMERICA:

EXSAMOTHEREQ: EQUATION
1>EXSAMOTHER=QSAMOTHER-CONSAMOTHER-(IESAMOTHER-IESAMOTHER\1)

QSAMOTHEREQ: EQUATION
1>QSAMOTHER= <280.026> + <0.762773>*QSAMOTHER\1 + <5.70501>*PR1\1 &&
2> + <388.521>*DSAMOTHER

CONSAMOTHER,IESAMOTHER = EXOGENOUS
```

```
AFRICA:

EXAFREQ: EQUATION
1>EXAFR=QAFR-CONAFR-(IEAFR-IEAFR\1)

QAFR2EQ: EQUATION
1>QAFR= <-3007.58> + <0.990399>*QAFR\1 + <31.4871>* &&
2>(((PR1\8+PR1\9+PR1\10)/3)) + <3045.99>*DAFR

CONAFR, IEAFR = EXOGENOUS
```

```
NORTH AMERICA:

EXNAMEQ: EQUATION
1>EXNAM=QNAM-CONNAM-(IENAM-IENAM\1)

QNAMEQ: EQUATION
1>QNAM= <2112.55> + <0.708054>*QNAM\1 + <20.5825>*PR1\1 &&
2> + <1185.16>*DNAM

CONNAM,IENAM = EXOGENOUS

ASIA AND OCEANIA:

EXASIA&OCEEQ: EQUATION
1>EXASIA&OCE=QASIA&OCE-CONASIA&OCE-(IEASIA&OCE-IEASIA&OCE\1)

QASIA&OCEEQ: EQUATION
1>QASIA&OCE= <-60.7836> + <0.972497>*QASIA&OCE\1 + <11.2852>*PR1\1 &&
2> - <0.392518>*(QASIA&OCE\1-(<-60.7836>+<0.972497>*QASIA&OCE\2+ &&
3><11.2852>*PR1\2))
(QASIA&OCEEQ HAS BEEN CORRECTED FOR FIRST ORDER AUTOCORRELATION)

CONASIA&OCE,IEASIA&OCE = EXOGENOUS

WORLD

EXWORLDEQ: EQUATION
1>EXWORLD=EXBRA+EXCOL+EXNAM+EXSAMOTHER+EXAFR+EXASIA&OCE

IEPRODTOTEQ: EQUATION
1>IEPROD=IEPRODXBRA+IEBRA

IEPRODXBRA = EXOGENOUS
```

IMPORTS BY COUNTRY AND REGION

```
UNITED STATES:

MUS3EQ: EQUATION
1>MUS= <28288.3> - <49.6904>*PR1 - <3.58319>*GNP$75US + <1.04776>* &&
2>(IEUS-IEUS\1 )

EUROPE:

MEUREQ: EQUATION
1>MEUR= <2008.35> - <63.2797>*PR1 + <17.8760>*GDP$75EUR

REST OF WORLD:

MOTHEREQ: EQUATION
1>MOTHER= <166.851> + <4.87825>*GDP$75EUR + <1176.5

WORLD:

MWORLDEQ: EQUATION
1>MWORLD=MUS+MEUR+MOTHER
```

PRICES

```
PR1OEQ: EQUATION
1>PR1= + <0.218438>*PR1\1 + <28.5251>* &&
2>(((MWORLD\1+MWORLD\2)/(IEPROD\1+EXWORLD))) + <18.8667>*DPR

P1EQ: EQUATION
1>P1=PR1*CPIUS

PICA76EQ: EQUATION
1>PICA76= <-0.770841> + <1.05888>*P1

PGUATEQ: EQUATION
1>PGUAT= <0.674788> + <1.14411>*P1
```

TABLE 1

LIST OF COFFEE MODEL VARIABLES
(As utilized in the econometric specification)

Symbol	Identification
	<u>Endogenous</u>
QBRA	Brazil coffee production
QCOL	Colombia coffee production
QSAMOTHER	Other South America coffee production
QAFR	Africa coffee production
QASIA&OCE	Asia and Oceania coffee production
QNAM	North America coffee production
QWORLD	World coffee production
EXBRA	Brazil coffee exports
EXCOL	Colombia coffee exports
EXSAMOTHER	Other South America coffee exports
EXAFR	Africa coffee exports
EXASIA&OCE	Asia and Oceania coffee exports
EXNAM	North America coffee exports
EXWORLD	World coffee exports
CONBRA	Brazil coffee consumption
CONCOL	Colombia coffee consumption
CONSAMOTHER	Other South America coffee consumption
CONAFR	Africa coffee consumption
CONASIA&OCE	Asia and Oceania coffee consumption
CONNAM	North America coffee consumption

PICA76	ICO composite indicator price, 1976 Agreement (unweighted average of robustas and other mild arabicas). This price series may have to be adjusted to reflect the new agreement formula.
PBRICA	Unwashed arabicas price (Brazilian, Santos No 4). This price series needs to be replaced by a better price such as U.S. unit value imports.
PCOL	ICO Colombian mild arabicas price (Colombian Mams). This price series needs to be replaced by a better price such as U.S. unit value imports or Guatemalan prime washed.
PMLA	ICO other mild arabicas price (El Salvador, Central Standard, Guatemalan Prime Washed, Mexico Price Washed).
PR1	U.S. Unit Import Value (Deflated) for coffee
P1	U.S. Unit Import Value for Coffee
PGUAT	Guatemala prime washed price
MUS	United States net coffee imports
MEUR	European gross coffee imports
MOTHER	Rest of World gross coffee
MWORLD	World gross coffee imports
IEBRA	Brazil coffee inventory (end of year)
IECOL	Colombia coffee inventory
IESAMOTHER	Other America coffee inventories
IEAFR	Africa coffee inventories
IEASIA&OCE	Asia and Oceania coffee inventories
IENAM	North America coffee inventories
IEPRODXBRA	Coffee inventories held by producers other than Brazil

IEPROD	Total producers coffee inventories
IEUS	United States green coffee inventories
AHBRA	Brazil acreage harvested (ha)
YLDBRA	Brazil coffee yield (60 kg bags/ha)
QINV	Inventories accumulated as a result of quota operations

	Exogenous
GNP$75US	GNP in United States at constant market prices
GDP$75EUR	GDP in OECD-Europe at constant market prices
T	Time trend variable
X^{quota}	ICA coffee export quota for world or for individual regions
CPIUS	United States Consumer Price Index
DPR	Dummy variable for PR1 based on ICA quotas and 1977 member disruption
DIBRA	Dummy variable for extremes in Brazil coffee inventories
RSTUS	Dummy variable for United States reported green coffee roastings
ACCUS	Dummy variable for United States apparent green coffee roastings
DCUS	Dummy variable for extremes in United States coffee roastings
DAFR	Dummy variable for Africa production cycle
DCOL	Dummy variable for Colombia production cycle
DNAM	Dummy variable for North America production cycle

DSAMOTHER	Dummy variable for Other South America production cycle
DMI	Dummy variable for extremes in rest of world imports

The testing of the model required that the estimated and actual values of the endogenous variables in the model be reasonably close over the sample period of model estimation, 1960-80. This closeness or accuracy can be measured in a number of ways, the most simple one being the mean average percent error (MAPE):

$$\text{MAPE} = \frac{1}{n} \sum_{t=1}^{n} \left| \frac{E_t - A_t}{A_t} \right| \times 100\%$$

where E_t = estimated value of a variable in time period t, A_t = its actual value, and n = number of time periods. Table 2 shows the MAPE for different versions of the coffee model tested. The final model selected HISTSIM831 shows reasonably good accuracy with less than 10 percent error for most variables. Brazilian exports proved as exception at 19.0 percent, largely because of the model's inability to simmulate erratic government intervention policies.

Table 2

MEAN AVERAGE PERCENT ERROR
FOR COFFEE MODEL ENDOGENOUS VARIABLES
OVER THE SAMPLE PERIOD
1960-1980

Endogenous Variables	MAPE Version 1	MAPE Version 2	MAPE[3] Version 3	MAPE[4] Version 4	MAPE[5] Version 5
QBRA	6.49	6.46	8.49	9.70	9.81
QCOL	3.46	3.18	3.62	4.79	4.83
QNAM	6.94	6.87	7.46	8.13	7.74
QSAMOTHER	4.96	4.64	5.56	6.13	5.85
QAFR	7.91	7.78	8.25	4.53	4.52
QASIA&OCE	4.65	4.93 [1]	5.95	7.10	6.64
QWORLD	3.46	3.12	2.75	2.46	2.39
MWORLD	2.45	2.28	2.49	2.85	2.68
MUS	3.99	3.18	3.26	3.50	3.41
MEUR	2.87	2.73	2.84	3.05	2.98
MOTHER	5.57	5.57	5.31	5.31	5.31
IEBRA	12.14	12.75 [1]	31.26	41.85	9.12
IEPROD	6.72	6.96	12.55	16.30	4.66
EXBRA	14.91		16.06	16.71	18.98
EXWORLD	7.40	7.19	5.52	4.80	4.77
PR1	10.30	12.08 [2]	11.36	10.76	11.07
AHBRA	6.49	6.46	8.49	9.70	9.81
ACCUS		2.52			
PICA76					12.41

1) Version WEDI700 - AR1 equations
2) Version Aug20A - PR1 equation uses EXWORLD rather than QWORLD
3) Version NEWHIST827 - With new USDA data
4) VersionHISTSIM828 - Coffee@HIST1 with all new equations required by USDA revisions
5) Version HISTSIM831 - Coffee@HIST1 with add factor for IEBRA

MODEL BASE FORECASTS

Problems of Model Forecasting. To evaluate the impact of the coffee export quota levels over the next five years, a base forecast extending from 1981-1986 had to be prepared. Three problems in particular had to be solved.

First, the exogenous variables in the model such as GNP and CPI had to be forecast over the same period. This was accomplished largely using forecasts in existing data banks, mainly those of Data Resources, Inc. Other exogenous variables to be forecast included consumption and inventories in the producing regions.

Second, the special class of exogenous variables, the dummy variables, had to be extrapolated into the future. This was accomplished by careful analysis of foreseeable market conditions, as explained in the next section.

Third, the slight differences between FAO demand data and USDA supply data had to be reconciled in the forecast period to facilitate export quota operations with the model. This was accomplished by equating imports with exports at the world level. A residual adjustment was then made and allocated to other importing regions.

Model Adjustment. The selection of values for the dummy variables in the model followed the perception of foreseeable market conditions. These conditions in turn have been checked with expert opinion so that a realistic model forecast could be proposed. The variables together with their values are reported in Table 3. Below a rationale is presented for each.

<u>Brazil</u>. The unexpected large production of 32,000,000 bags for Brazil in 1981 required that several related variables be adjusted. First, an absolute increment of 5,000,000 bags (<u>QBRA</u>) was added to the model's prediction. Second, crop yields that were predicted exogenously were increased from 9 to 11 bags/hectare for 1981. Brazilian inventories (<u>IEBRA</u>) also were decreased and placed in sales to prevent overaccumulation. Finally, area harvested (<u>AHBRA</u>) as predicted by the model grew too sharply and the area was decreased to make the prediction more realistic.

TABLE 3

EXOGENOUS VARIABLE ADJUSTMENTS
FOR THE FORECAST PERIOD, 1981-86

	DAFR	DCOL	DCUS	DIBRA	DMI	DNAM	DPR	DSAMOTHER
1981	0.500	0.500	0.000	0.000	0.000	0.500	0.000	0.500
1982	0.500	0.500	0.000	0.000	0.000	0.500	-0.500	0.500
1983	0.750	0.000	0.000	0.000	0.000	0.500	0.000	0.500
1984	0.750	0.500	0.000	0.000	0.000	0.500	0.000	0.500
1985	0.750	0.000	0.000	0.000	0.000	0.500	0.000	0.500
1986	0.750	0.500	0.000	0.000	0.000	0.500	0.000	0.500

	$AHBRA	$QBRA	$IEBRA	$PR1	$MEUR
1981	0.000	5,000.000	-3,000.000	-16.000	-2,000.000
1982	0.000	0.000	0.000	0.000	-2,000.000
1983	0.000	0.000	0.000	0.000	-2,000.000
1984	-1,000.000	0.000	0.000	0.750	-4,000.000
1985	0.000	0.000	0.000	2.000	-4,000.000
1986	0.000	0.000	0.000	3.000	-5,000.000

Colombia. The dummy variable reflecting cyclical fluctuations in the coffee tree production cycle DCOL was changed from 0 - 1 variation to 0 - 0.5 variation to reflect the declining influence of this cycle in Colombia.

Africa, South America and North America. The cyclical production dummies were changed from 0 - 1 variation to a constant 0.5 value to reflect the declining influence of this cycle, i.e., DAFR, DNAM, and DSAMOTHER. The increase in the value to 0.750 in later years for Africa reflects the cumulative effect of increased tree plantings on African production.

Europe. Because coffee consumption in Europe is believed to be near saturation level, the model's prediction which did not include this factor were too high and a downward adjustment has been made. See MEUR.

Prices. A dummy variable DPR has been used to account for direct, unusual frost effects on coffee prices. An adjustment is shown in 1982 to reflect the Brazilian frost condition carrying over from 1981.

Base Forecast Validation. Given the above model adjustments, a base forecast has been produced which provides the "most likely" coffee market scenario under free market conditions, i.e., with no international coffee agreement including export quotas in effect during the forecast period. The export quota simulations are then tested with this scenario as the basic market outlook. The base forecast for the major endogenous variables is summarized in Table 4.

Table 4

COFFEE MODEL BASE FORECASTS 1981-1986

	1981	1982	1983	1984	1985	1986
QBRA.SET2	33,394.944	18,017.173	25,770.683	24,515.621	25,313.632	27,745.655
QCOL.SET2	14,657.228	15,051.159	14,667.840	15,115.416	14,877.715	15,343.234
QNAM.SET2	14,559.935	13,795.217	13,121.528	12,875.197	12,735.025	12,621.730
QSAMOTHER.SET2	3,820.723	3,605.070	3,403.925	3,314.435	3,255.667	3,206.947
QAFR.SET2	18,894.578	18,435.129	18,742.002	19,287.186	20,329.706	21,716.188
QASIA&OCE.SET2	9,522.480	9,627.942	9,658.004	9,813.718	9,983.925	10,141.749

	1981	1982	1983	1984	1985	1986
CONBRA	8,500.000	8,600.000	8,700.000	8,800.000	8,900.000	9,000.000
CONCOL	1,850.000	1,900.000	1,950.000	2,000.000	2,050.000	2,100.000
CONNAM	3,817.000	3,675.000	3,700.000	3,725.000	3,750.000	3,775.000
CONSAMOTHER	1,559.000	1,575.000	1,600.000	1,625.000	1,650.000	1,675.000
CONAFR	2,697.000	2,740.000	2,790.000	2,840.000	2,990.000	3,040.000
CONASIA&OCE	2,792.000	2,800.000	2,850.000	2,900.000	2,950.000	3,000.000

	1981	1982	1983	1984	1985	1986
IEBRA	19,482.696	14,362.949	17,415.545	19,300.200	21,792.070	26,193.331
IEPRODXBRA	28,431.000	28,431.000	28,431.000	28,431.000	28,431.000	28,431.000
IEPROD	47,913.696	42,793.949	45,846.545	47,731.200	50,223.070	54,624.331

	1981	1982	1983	1984	1985	1986
EXBRA	17,318.197	14,536.919	14,018.087	13,830.966	13,921.762	14,344.393
EXCOL	10,657.228	12,121.159	11,717.840	12,115.416	11,827.715	12,243.234
EXNAM	10,374.935	10,120.217	9,421.528	9,150.197	8,985.025	8,846.730
EXSAMOTHER	1,293.723	2,840.070	1,803.925	1,689.435	1,605.667	1,531.947
EXAFR	15,323.578	15,695.129	15,952.002	16,447.186	17,339.706	18,676.188
EXASIA&OCE	5,683.480	6,827.942	6,808.004	6,913.718	7,033.925	7,141.749

	1981	1982	1983	1984	1985	1986
QWORLD	94,849.887	78,531.691	85,363.982	84,921.573	86,495.670	90,775.502
EXWORLD	60,651.140	62,141.437	59,721.386	60,146.918	60,713.800	62,784.240
MWORLD	63,637.239	65,158.454	65,092.535	64,194.841	64,998.578	65,647.051
MUS	19,495.068	19,676.832	18,895.472	18,543.854	18,298.711	18,156.793
MEUR	34,034.617	35,174.060	35,584.074	34,703.722	35,536.992	35,964.515
MOTHER	10,107.554	10,307.562	10,612.989	10,947.266	11,162.875	11,525.744

	1981	1982	1983	1984	1985	1986
PR1	37.938	31.514	42.722	44.385	43.703	42.157
P1	102.995	93.005	136.031	151.922	161.862	168.642
PICA76	108.289	97.710	143.270	160.096	170.621	177.801

A typical problem of forecasting with a model is that the accuracy of the forecasts in a future period cannot be determined, since actual values are not available for comparison with forecast values. One approach is to start the forecasts earlier, to "save" several periods for comparision. The approach deemed most useful here is to compare the model's forecasts with some alternative forecasts that could be said to reflect "expert" judgment. Below such a comparison is made for a selected set of variables. The source of the alternative forecasts are unofficial "expert" forecasts by economists from the World Bank and other institutions.

The pattern of world coffee trade forecast by the model is compared to the expert forecasts in Table 5. The expert production forecasts reflect a growth rate of 1.4 percent from the actual 1980 value. The model forecast of 90,776,000 bags for 1986 compares favorably to the export forecast of 89,943,000 bags. The model forecast in the interim years, however, reflects changing production conditions. For example, the large 1981 and small 1982 production forecasts reflect the Brazilian influence, a bumper crop followed by a frost-induced decline. Other producers catch up in 1983 but relatively lower prices in previous years stall any further production growth until 1985 and 1986.

The model's export forecast of 62,784,000 bags approximates that of the experts at 63,752,000 tons by 1986. The latter reflects a growth rate of 1.2 percent from the 1980 actual value. Fluctuations in intervening years reflect the carryover of production from 1981 to 1982 as well as the other stated production conditions.

Table 5

MODEL FORECAST COMPARISON FOR
WORLD PRODUCTION AND EXPORTS
1981-1986

	PRODUCTION *		EXPORTS *	
	Expert Forecast	Model Forecast	Expert Forecast	Model Forecast
1980	82,745	78,778	59,850	55,186
1981	83,903	94,850	60,060	60,651
1982	85,078	78,531	60,783	62,141
1983	86,269	85,363	61,512	59,721
1984	87,477	84,921	62,250	60,147
1985	88,702	86,496	62,997	60,713
1986	89,943	90,776	63,752	62,784

*000/bags

Underlying the above world production and export forecasts are those of individual countries and regions. Forecast comparisons for Brazil, Colombia, and Africa are shown in Tables 6, 7, and 8. The model's prediction of Brazilian production conditions reflects the bumper crop and subsequent frost of 1981. By 1985 the model forecasts exceed the experts' forecast; this largely reflects the increasing number of coffee trees in Brazil. The experts forecast is based on a growth rate of 3.7 percent from 1980. Exports, however, are expected to grow more slowly: the experts employed a growth rate of 3.1 percent from 1980. Both the expert forecasts and model forecasts are very similar for 1984, 1985, and 1986. The model does not forecast a greater export level; even though Brazil's production is increasing, world imports are expected to slow down, preventing a higher export level. In addition, Brazilian coffee inventories, determined endogenously, are expected to increase over the forecast period.

The model prediction for Colombia's production grows at about the same rate as the experts. The latter is based on a 1.4 percent growth rate from the 1980 level. However, an annual fluctuation can be perceived because of the cyclical crop production pattern. This same pattern is reflected in Colombia's exports. The growth rate of 1.0 percent suggested in the experts forecasts is less then that of the model. This increase is based on the assumption of a relative increase in the demand for milds.

The model and expert forecasts for African production and exports are given in Table 8. The expert production forecasts are based on a growth rate of 2.4 percent from 1980 and the export forecasts on 3.1 percent. In both cases, the forecasts are similar by 1986. The model forecasts show more realistically the impact of crop fluctuations on production and exports.

Table 6

MODEL FORECAST COMPARISON FOR
BRAZIL PRODUCTION AND EXPORTS
1980-1986

	PRODUCTION*		EXPORTS*	
	Expert Forecast	Model Forecast	Expert Forecast	Model Forecast
1980	20,000	18,069	12,000	13,428
1981	20,740	33,395	12,372	17,318
1982	21,507	18,017	12,755	14,536
1983	22,303	25,771	13,151	14,018
1984	23,128	24,516	13,554	13,831
1985	23,989	25,314	13,979	13,922
1986	24,872	27,746	14,413	14,343

Table 7

MODEL FORECAST COMPARISON FOR
COLOMBIA PRODUCTION AND EXPORTS
1981-1986

	PRODUCTION*		EXPORTS*	
	Expert Forecast	Model Forecast	Expert Forecast	Model Forecast
1980	14,000	13,889	9,750	9,638
1981	14,196	14,657	9,848	10,657
1982	14,395	15,051	9,946	12,121
1983	14,596	14,668	10,045	11,718
1984	14,801	15,115	10,146	12,115
1985	15,008	14,878	10,247	11,828
1986	15,218	15,343	10,349	12,242

Table 8

MODEL FORECAST COMPARISON FOR
AFRICA PRODUCTION AND EXPORTS
1981-1986

	PRODUCTION*		EXPORTS*	
	Expert Forecast	Model Forecast	Expert Forecast	Model Forecast
1980	19,171	19,392	14,052	14,795
1981	18,950	18,894	15,441	15,324
1982	19,405	18,435	15,920	15,695
1983	19,870	18,742	16,413	15,952
1984	20,347	19,287	16,922	16,447
1985	20,836	20,329	17,446	17,340
1986	21,336	21,716	17,987	18,676

*000/bags

No forecast comparisons appear for the other producing regions in the model, since expert forecasts could not easily be assembled for these regions. The declining values of production and exports for North America reflect the expected continued downward trend in coffee production in this region due to coffee rust problems, the associated high cost of production, and increasing political instability in the major producing countries.

The forecast comparisons for world imports is given in Table 9. The expert forecast is based on a growth rate of 1.2 percent from an estimate of 1980 imports. The model forecast for 1986 is 65,647,000 bags compared to 63,753,000 bags for the expert forecasts. The world import levels reached for 1981 increase only slightly by the end of the forecast period, reflecting the model's assumption of relative saturation of coffee demand in the United States and in Europe.

The final comparison is that of prices. Model forecasts have been prepared for the basic model price, the U.S. unit import value, as well as the Guatemala Prime washed price. Except for 1981 and 1982 the model's prices are above the expert forecast price. The model better reflects the changes in production and exports occuring in response to the Brazilian situation.

Table 9

MODEL FORECAST COMPARISON FOR
WORLD IMPORTS*

	Expert Forecast	Model Forecast
1980	62,000	62,372
1981	60,060	63,637
1982	60,783	65,158
1983	61,512	65,092
1984	62,250	64,194
1985	62,997	64,998
1986	63,753	65,647

Table 10

MODEL FORECAST COMPARISON FOR PRICES
(Current value, 1981-1986)

	Guatemala Prime Washed		U.S. Unit Import Value	
	Expert Forecast	Model Forecast	Expert Forecast	Model Forecast
1980	164.3	209.2	141.9	182.3
1981	127.3	118.5	109.9	103.0
1982	134.1	107.1	115.8	93.0
1983	147.9	156.3	127.7	136.0
1984	161.6	174.5	134.6	151.9
1985	175.4	185.9	151.5	161.9
1986	189.2	193.6	163.4	168.6

Policy Simulation of Quota Levels

Model Simulation Program. The theoretical specification of the submodel that would predict the impact of alternative quota level and trigger price mechanism policies has been described in the project papers cited earlier, "Model Description" and "Interim Report." The translation of that theory into an effective agreement evaluation submodel has been accomplished by constructing an overall model framework. This framework described in Appendix 2 can be operated interactively with the model using the DRI network. The model equations used for the quota simulation are contained in Appendix 3.

The program featuring the quota simulation framework attempts to maintain coffee prices within the price range specified by the agreement. Block I of the model shown in Appendix 2 decides whether coffee should be placed into stocks or removed from stocks. In the former case, the program advances to Block II of the model and stocks reflecting differences between export levels and quota levels are stored. In the case of higher prices and the need to place stocks on the market, the program advances to Block III of the model. Coffee stocks are liquidated to help move prices within the specified range.

Not included in the Appendix 2 are a set of additional statements and equations that determine changes in revenue resulting from quota operations for the various exporting and importing regions in the model.

<u>Selecting Quota Allocations</u>. To perform simulation analysis with the quota program, it is necessary to establish quota levels for testing and then to allocate them among the exporting countries belonging to the ICA. The quota levels to be analyzed are those reflecting the policy position of the U.S. Government, some 55-56 million bags at the world level.

To allocate these global quotas among countries, either the allocation can be given or it can be generated on the basis of past allocations. The latter approach has been employed initially. The following listing shows the distribution of the basic ICA annual quota of 57,370,000 bags for the crop year 1980/1981 together with the distribution of non-quota exports. Aggregations have been performed such that the regions reported conform to those of the coffee world.

Region	Basic Quota	Non-Quota	Total
Brazil	14.5	0	14.500
Colombia	9.7	0	9.700
North America	10.5	0.780	11.280
Other S. America	2.2	0.163	2.363
Africa	13.2	0.984	14.148
Asia and Oceania	5.0	0.373	5.373
Total (000 bags)			57.364

Here non-quota exports of 2,300,000 bags were allocated according to the percentage distribution of the basic quota among these four regions. The total export allocations shown in the final column after being converted to percentages provide the basis for the export allocations in the quota program.

A simulation for the period 1982-86 was performed under the assumption that an International Coffee Agreement (ICA) similar to the one currently in effect (export quotas as described in the previous paragraph and a price range of $1.15-1.55/lb.) is in operation over this period. As shown below, the simulation suggests that the ICA would not be successful in keeping prices within the specified range: the price is below the floor in 1982 and above the ceiling in 1984-86 (the price is within the range in 1983, as it also was in the base simulation). This appears to be because the stocks accumulated in the (unsuccessful) attempt to raise prices in 1982 are exhausted in 1984, the first year of pressure on the ceiling, leaving little in the way of stocks to defend the ceiling in 1985-86.

One point that should be made at this time is that a comparison of projected "free market" export levels (Table 4) with the export quotas used for this simulation shows that Brazil, North America, and South America will likely not be able to meet their quotas 1982-86, while Colombia, Africa and Asia and Oceania could easily exceed theirs. This means that the pattern of inventory accumulation and liquidation simulated by the model may not accurately reflect the actual pattern. The ICA has provisions regarding the reallocation of export quota shortfalls, and clearly it would be desirable to include an export quota reallocation feature in the next version of the coffee model.

PRICE
(PICA76)

Year	Base Forecast	Quota Forecast
1982	$0.98	$1.09
1983	1.43	1.55
1984	1.60	1.67
1985	1.71	1.77
1986	1.78	1.82

Appendix 1

Equation Statistics

AHBRAEQ

LEAST SQUARES WITH FIRST-ORDER AUTOCORRELATION CORRECTION

ANNUAL(1961 TO 1980) 20 OBSERVATIONS
DEPENDENT VARIABLE: AHBRA

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	281.225	227.5	1.236	CONSTANT
1)	0.559341	0.1301	4.299	AHBRA\1
2)	20.6913	6.896	3.000	PR1\7
	0.474394	0.2763	1.717	RHO

R-BAR SQUARED: 0.9594
DURBIN-WATSON STATISTIC: 1.4323
STANDARD ERROR OF THE REGRESSION: 157.7 NORMALIZED: 0.05739

IEBRAEQ

LEAST SQUARES WITH FIRST-ORDER AUTOCORRELATION CORRECTION

ANNUAL(1961 TO 1980) 20 OBSERVATIONS
DEPENDENT VARIABLE: IEBRA

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	-17556.0	2236	-7.853	CONSTANT
1)	0.883839	0.03300	26.78	(IEBRA\1+QBRA)
2)	4490.96	1171	3.835	DIBRA
	0.408299	0.2433	1.678	RHO

R-BAR SQUARED: 0.9901
DURBIN-WATSON STATISTIC: 1.7552
STANDARD ERROR OF THE REGRESSION: 2491 NORMALIZED: 0.06636

Appendix 1 (continued)

QCOLEQ

LEAST SQUARES WITH FIRST-ORDER AUTOCORRELATION CORRECTION

ANNUAL(1961 TO 1980) 20 OBSERVATIONS
DEPENDENT VARIABLE: QCOL

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	-1237.55	408.7	-3.028	CONSTANT
1)	1.03342	0.06784	15.23	QCOL\1
2)	11.1456	5.426	2.054	PR1\1
3)	1437.51	165.8	8.669	DCOL
	-0.631282	0.2014	-3.135	RHO

R-BAR SQUARED: 0.9776
DURBIN-WATSON STATISTIC: 1.8176
STANDARD ERROR OF THE REGRESSION: 297.6 NORMALIZED: 0.03313

QSAMOTHEREQ

ORDINARY LEAST SQUARES

ANNUAL(1961 TO 1980) 20 OBSERVATIONS
DEPENDENT VARIABLE: QSAMOTHER

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	280.026	348.5	0.8034	CONSTANT
1)	0.762773	0.1267	6.018	QSAMOTHER\1
2)	5.70501	3.501	1.629	PR1\1
3)	388.521	122.5	3.170	DSAMOTHER

R-BAR SQUARED: 0.8263
DURBIN-WATSON STATISTIC: 2.0513
STANDARD ERROR OF THE REGRESSION: 236.1 NORMALIZED: 0.07479

QNAM

ORDINARY LEAST SQUARES

ANNUAL(1960 TO 1980) 21 OBSERVATIONS
DEPENDENT VARIABLE: QNAM

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	2112.55	1235	1.710	CONSTANT
1)	0.708054	0.1185	5.975	QNAM\1
2)	20.5825	12.24	1.682	PR1\1
3)	1185.16	376.4	3.149	DNAM

R-BAR SQUARED: 0.8147
DURBIN-WATSON STATISTIC: 2.1949
STANDARD ERROR OF THE REGRESSION: 881.6 NORMALIZED: 0.07107

QAFR2EQ

ORDINARY LEAST SQUARES

ANNUAL(1960 TO 1980) 21 OBSERVATIONS
DEPENDENT VARIABLE: QAFR

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	-3007.58	2136	-1.408	CONSTANT
1)	0.990399	0.07940	12.47	QAFR\1
2)	31.4871	14.76	2.133	((PR1\8+PR1\9+PR1\10)/3)
3)	3045.99	295.9	10.30	DAFR

R-BAR SQUARED: 0.9485
DURBIN-WATSON STATISTIC: 1.7811
STANDARD ERROR OF THE REGRESSION: 557.6 NORMALIZED: 0.03045

QASIA&OCEEQ

LEAST SQUARES WITH FIRST-ORDER AUTOCORRELATION CORRECTION

ANNUAL(1961 TO 1980) 20 OBSERVATIONS
DEPENDENT VARIABLE: QASIA&OCE

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	-60.7836	261.2	-0.2327	CONSTANT
1)	0.972497	0.07706	12.62	QASIA&OCE\1
2)	11.2852	5.864	1.924	PR1\1
	-0.392518	0.2417	-1.624	RHO

R-BAR SQUARED: 0.9474
DURBIN-WATSON STATISTIC: 2.1261
STANDARD ERROR OF THE REGRESSION: 394.2 NORMALIZED: 0.06937

MUS3EQ

ORDINARY LEAST SQUARES

ANNUAL(1960 TO 1980) 21 OBSERVATIONS
DEPENDENT VARIABLE: MUS

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	28611.2	874.6	32.71	CONSTANT
1)	-49.7558	11.72	-4.245	PR1
2)	-3.84711	0.8095	-4.753	GNP$75US
3)	1.03113	0.1713	6.018	IEUS-IEUS\1

R-BAR SQUARED: 0.8970
DURBIN-WATSON STATISTIC: 2.0965
STANDARD ERROR OF THE REGRESSION: 786.4 NORMALIZED: 0.03761

MEUREQ

ORDINARY LEAST SQUARES

ANNUAL(1960 TO 1979) 20 OBSERVATIONS
DEPENDENT VARIABLE: MEUR

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	2008.35	854.6	2.350	CONSTANT
1)	-63.2797	11.85	-5.341	PR1
2)	17.8760	0.7094	25.20	GDP$75EUR

R-BAR SQUARED: 0.9769
DURBIN-WATSON STATISTIC: 1.8719
STANDARD ERROR OF THE REGRESSION: 834.2 NORMALIZED: 0.03255

MOTHEREQ

ORDINARY LEAST SQUARES

ANNUAL(1960 TO 1979) 20 OBSERVATIONS
DEPENDENT VARIABLE: MOTHER

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	166.851	552.0	0.3023	CONSTANT
1)	4.87825	0.3761	12.97	GDP$75EUR
2)	1176.67	419.4	2.806	DMI

R-BAR SQUARED: 0.9031
DURBIN-WATSON STATISTIC: 2.0761
STANDARD ERROR OF THE REGRESSION: 504.4 NORMALIZED: 0.06927

PR1QEQ

ORDINARY LEAST SQUARES

ANNUAL(1962 TO 1980) 19 OBSERVATIONS
DEPENDENT VARIABLE: PR1

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
1)	0.218438	0.08613	2.536	PR1\1
2)	28.5251	3.914	7.288	((MWORLD\1+MWORLD\2)/ (IEPROD\1+EXWORLD))
3)	18.8667	2.850	6.620	DPR

R-BAR SQUARED: 0.9221 (RELATIVE TO Y=0, RBSQ: 0.9874)
DURBIN-WATSON STATISTIC: 1.5041
STANDARD ERROR OF THE REGRESSION: 5.996 NORMALIZED: 0.1259

PICA76EQ

ORDINARY LEAST SQUARES

ANNUAL(1960 TO 1980) 21 OBSERVATIONS
DEPENDENT VARIABLE: PICA76

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	-0.770841	3.565	-0.2162	CONSTANT
1)	1.05888	0.04119	25.71	P1

R-BAR SQUARED: 0.9706
DURBIN-WATSON STATISTIC: 1.7458
STANDARD ERROR OF THE REGRESSION: 9.987 NORMALIZED: 0.1392

PGUATEQ

ORDINARY LEAST SQUARES

ANNUAL(1960 TO 1979) 20 OBSERVATIONS
DEPENDENT VARIABLE: PGUAT

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	0.674788	2.774	0.2433	CONSTANT
1)	1.14411	0.03451	33.16	P1

R-BAR SQUARED: 0.9830
DURBIN-WATSON STATISTIC: 1.9698
STANDARD ERROR OF THE REGRESSION: 7.597 NORMALIZED: 0.1035

Appendix 2

LOGICAL STRUCTURE FOR OPERATION OF COFFEE MODEL UNDER INTERNATIONAL COFFEE AGREEMENT (ICA) CONTAINING EXPORT QUOTAS AND PRODUCER ACCUMULATION/LIQUIDATION OF STOCKS TO KEEP COFFEE PRICE WITHIN RANGE SPECIFIED BY AGREEMENT

I. Basic Coffee Model Solution

SOLVE (t) COFFEEMODEL
IF Price less than \$1.15 THEN "Export Quotas and Stock Accumulation"
IF Price greater than \$1.55 THEN "Stock Liquidation"
IF \$1.15 ≤ Price ≤ \$1.55 THEN SOLVE (t+1) COFFEEMODEL

II. "Export Quotas and Stock Accumulation"

QEXWORLD = ICA global export quota (000 bags) = a series
QEX@Region = ICA export quota assigned to each country or region (000 bags) = a series
QQ = export quota cuts = V(.975,.950,.925,.900)
EXPORTS@Region = QQ*QEX@Region and
QINV@Region = stocks accumulated through quota operation
= QEX@Region-EXPORTS@Region
SOLVE(t) COFFEEMODEL for new EXPORTS@Region
IF \$1.115 ≤ Price ≤ \$1.55 THEN SOLVE(t+1) COFFEEMODEL ELSE try next QQ and new EXPORTS@Region
IF after all QQ have been tried and \$1.15> Price THEN exit with message "Quota cuts and stock accumulation are insufficient to move price into ICA range; this occurs in year t."

III. "Stock Liquidation"

LQQ = rate of stock liquidation = V(0.1 to 1.0, step 0.1)
EXPORTS@Region = QEX@Region + LQQ*SUM(QINV@Region)
SUM(QINV@Region) = SUM(QINV@Region) - LQQ*SUM(QINV@Region)
(this expression can be negative)
IF SUM(QINV@ALL Regions) > 0 THEN SOLVE (t) COFFEEMODEL with new EXPORTS@Region ELSE exit with message "Liquidation of stocks accumulated under quota operation is insufficient to move price into ICA range; stocks reach 0 in year t."
IF \$1.15 ≤ Price ≤ \$1.55 then SOLVE (t+1) COFFEEMODEL ELSE try next LQQ (eventually SUM(QINV@ALL Regions) will reach 0)

Appendix 3

Model Used for Quota Simulation

```
QCOLEQ: EQUATION
1>QCOL= <-1237.55> + <1.03342>*QCOL\1 + <11.1456>*PR1\1 $$
2> + <1437.51>*DCOL - <0.631282>*(QCOL\1-(<-1237.55>+<1.03342>* $$
3>QCOL\2+<11.1456>*PR1\2+<1437.51>*DCOL\1))

QNAMEQ: EQUATION
1>QNAM= <2112.55> + <0.708054>*QNAM\1 + <20.5825>*PR1\1 $$
2> + <1185.16>*DNAM

QASIA&OCEEQ: EQUATION
1>QASIA&OCE= <-60.7836> + <0.972497>*QASIA&OCE\1 + <11.2852>*PR1\1 $$
2> - <0.392518>*(QASIA&OCE\1-(<-60.7836>+<0.972497>*QASIA&OCE\2+ $$
3><11.2852>*PR1\2))

QSAMOTHEREQ: EQUATION
1>QSAMOTHER= <280.026> + <0.762773>*QSAMOTHER\1 + <5.70501>*PR1\1 $$
2> + <388.521>*DSAMOTHER

AHBRAEQ: EQUATION
1>AHBRA= <281.225> + <0.559341>*AHBRA\1 + <20.6913>*PR1\7 $$
2> + <0.474394>*(AHBRA\1-(<281.225>+<0.559341>*AHBRA\2+<20.6913>* $$
3>PR1\8))

QBRAEQ: EQUATION
1>QBRA=AHBRA*YLDBRA

IEBRAEQ: EQUATION
1>IEBRA= <-17556.0> + <0.883839>*((IEBRA\1+QBRA)) + <4490.96>*DIBRA $$
2> + <0.408299>*(IEBRA\1-(<-17556.0>+<0.883839>*((IEBRA\2+QBRA\1)) $$
3>+<4490.96>*DIBRA\1))

QAFR2EQ: EQUATION
1>QAFR= <-3007.58> + <0.990399>*QAFR\1 + <31.4871>* $$
2>(((PR1\8+PR1\9+PR1\10)/3)) + <3045.99>*DAFR

QWORLDEQ: EQUATION
1>QWORLD=QBRA+QCOL+QNAM+QSAMOTHER+QAFR+QASIA&OCE

QINVBRAEQ: EQUATION
1>QINVBRA=IF (QBRA-CONBRA-(IEBRA-IEBRA\1)) LEQ QEXBRA THEN QINVBRA\1
  ELSE $$
2>((QBRA-CONBRA-(IEBRA-IEBRA\1))-QEXBRA)+QINVBRA\1

QINVCOLEQ: EQUATION
1>QINVCOL=IF (QCOL-CONCOL-(IECOL-IECOL\1)) LEQ QEXCOL THEN QINVCOL\1
  ELSE $$
2>((QCOL-CONCOL-(IECOL-IECOL\1))-QEXCOL)+QINVCOL\1

QINVNAMEQ: EQUATION
1>QINVNAM=IF (QNAM-CONNAM-(IENAM-IENAM\1)) LEQ QEXNAM THEN QINVNAM\1
  ELSE $$
2>((QNAM-CONNAM-(IENAM-IENAM\1))-QEXNAM)+QINVNAM\1

QINVAFREQ: EQUATION
1>QINVAFR=IF (QAFR-CONAFR-(IEAFR-IEAFR\1)) LEQ QEXAFR THEN QINVAFR\1
  ELSE $$
2>((QAFR-CONAFR-(IEAFR-IEAFR\1))-QEXAFR)+QINVAFR\1

QINVASIA&OCEEQ: EQUATION
1>QINVASIA&OCE=IF (QASIA&OCE-CONASIA&OCE-(IEASIA&OCE-IEASIA&OCE\1)) LEQ
  $$
2>QEXASIA&OCE THEN QINVASIA&OCE\1 ELSE $$
3>((QASIA&OCE-CONASIA&OCE-(IEASIA&OCE-IEASIA&OCE\1))-QEXASIA&OCE)+
  QINVASIA&OCE\1
```

```
QINVSAMOTHEREQ: EQUATION
1>QINVSAMOTHER=IF (QSAMOTHER-CONSAMOTHER-(IESAMOTHER-IESAMOTHER\1)) LEQ
  &&
2>QEXSAMOTHER THEN QINVSAMOTHER\1 ELSE &&
3>((QSAMOTHER-CONSAMOTHER-(IESAMOTHER-IESAMOTHER\1))-QEXSAMOTHER)+
  QINVSAMOTHER\1

EXBRAQEQ: EQUATION
1>EXBRA=IF (QBRA-CONBRA-(IEBRA-IEBRA\1)) LEQ QEXBRA THEN EXBRA ELSE &&
2>QEXBRA

EXCOLQEQ: EQUATION
1>EXCOL=IF (QCOL-CONCOL-(IECOL-IECOL\1)) LEQ QEXCOL THEN EXCOL ELSE &&
2>QEXCOL

EXSAMOTHERQEQ: EQUATION
1>EXSAMOTHER=IF (QSAMOTHER-CONSAMOTHER-(IESAMOTHER-IESAMOTHER\1)) LEQ &&
2>QEXSAMOTHER THEN EXSAMOTHER ELSE QEXSAMOTHER

EXAFRQEQ: EQUATION
1>EXAFR=IF (QAFR-CONAFR-(IEAFR-IEAFR\1)) LEQ QEXAFR THEN EXAFR ELSE &&
2>QEXAFR

EXASIA&OCEQEQ: EQUATION
1>EXASIA&OCE=IF (QASIA&OCE-CONASIA&OCE-(IEASIA&OCE-IEASIA&OCE\1)) LEQ &&
2>QEXASIA&OCE THEN EXASIA&OCE ELSE QEXASIA&OCE

EXWORLDEQ: EQUATION
1>EXWORLD=EXBRA+EXCOL+EXNAM+EXSAMOTHER+EXAFR+EXASIA&OCE

EXNAMQEQ: EQUATION
1>EXNAM=IF (QNAM-CONNAM-(IENAM-IENAM\1)) LEQ QEXNAM THEN EXNAM ELSE &&
2>QEXNAM

PR1QEQ: EQUATION
1>PR1= + <0.218438>*PR1\1 + <28.5251>* &&
2>(((MWORLD\1+MWORLD\2)/(IEPROD\1+EXWORLD))) + <18.8667>*DPR

MUSQEQ: EQUATION
1>MUS=IF (<28288.3>-<49.6904>*PR1-<3.58319>*GNP$75US+<1.04776>*&&
2>(IEUS-IEUS\1)) LEQ A1*EXWORLD THEN MUS ELSE A1*EXWORLD

MEURQEQ: EQUATION
1>MEUR=IF (<2008.35>-<63.2797>*PR1+<17.876>*GDP$75EUR) LEQ &&
2>A2*EXWORLD THEN MEUR ELSE A2*EXWORLD

MOTHERQEQ: EQUATION
1>MOTHER=IF (<166.851>+<4.87825>*GDP$75EUR+<1176.67>*DMI) LEQ &&
2>A3*EXWORLD THEN MOTHER ELSE A3*EXWORLD

P1EQ: EQUATION
1>P1=PR1*CPIUS

IEPRODTOTEQ: EQUATION
1>IEPROD=IEPRODXBRA+IEBRA

PICA76EQ: EQUATION
1>PICA76= <-0.770841> + <1.05888>*P1

MWORLDEQ: EQUATION
1>MWORLD=MUS+MEUR+MOTHER

ACCUSEQ: EQUATION
1>ACCUS= <26875.5> - <40.0123>*PR1 - <2.89770>*GNP$75US &&
2> + <987.383>*DCUS

QINVTOTEQ: EQUATION
1>QINVTOT=QINVBRA+QINVCOL+QINVNAM+QINVSAMOTHER+QINVAFR+QINVASIA&OCE
```

```
PGUATEQ: EQUATION
1>PGUAT= <0.674788> + <1.14411>*P1

PBRICAEQ: EQUATION
1>PBRICA= <-7.04041> + <1.33736>*P1

PCOLEQ: EQUATION
1>PCOL= <6.80259> + <1.13986>*P1

PMLAEQ: EQUATION
1>PMLA= <6.76494> + <1.13934>*P1

POTHERMILDEQ: EQUATION
1>POTHERMILD= + <1.09966>*P1

PROBUSTAEQ: EQUATION
1>PROBUSTA= <-8.60254> + <1.11112>*P1
```

Routines (Based on Appendix 2) Used for Quota Simulation

```
SOLVE: ROUTINE
0.5>DO FINISHER
1  >SET INT=82 TO 86
2  >ORIGMODEL=COFFEE@QUOTA2
3  >DO START

START: ROUTINE
0.5 >LOOP I DATED @INT BEGIN <INT=I>
0.75>DISPLAY "SOLVING  "::STRING(YEAR(STARTDATE(@INT))),/
1    >SOLVE<WARNINGS=NULL> ORIGMODEL
2    >IF PICA76 LEQ 115 THEN DO LOW975
3    >ELSE GO TO DECIDE1
4    >DECIDE1:IF PICA76 GEQ 155 THEN DO SUMINVS01
5    >         ELSE DO FINISHER
5.5 >
5.6 >
5.7 >
5.8 >
6    >END

DECIDE2: ROUTINE
1>IF PICA76 LEQ 115 THEN DO LOW975
2>    ELSE DO FINISHER

FINISHER: ROUTINE
1>COFFEE@QUOTA2=ORIGMODEL
2>COFFEE@QUOTA2=ORDER(COFFEE@QUOTA2)
3>QEXBRA=14500
4>QEXCOL=9700
5>QEXNAM=11280
6>QEXSAMOTHER=2363
7>QEXAFR=14148
8>QEXASIA&OCE=5373
9>IF SPECIFIED(SUM@ALL) THEN DO NEWQINV

LOW975: ROUTINE
0.05>DO FINISHER
0.1 >LOOP I BY QUOTAS BEGIN
0.2 >   I=I*.975
0.3 >   END
3    >SOLVE COFFEE@QUOTA2
4    >TRACKLOW=V(.975)
5    >IF PICA76 LEQ 115 THEN DO LOW950
6    >        ELSE GO TO DECIDE1
7    >DECIDE1:IF PICA76 GEQ 155 THEN DO SUMINVS01
8    >         ELSE DO FINISHER
```

```
LOW950: ROUTINE
DO FINISHER
LOOP I BY QUOTAS BEGIN
   I=I*.95
      END
SOLVE COFFEE@QUOTA2
   TRACKLOW=V(TRACKLOW,.95)
IF PICA76 LEQ 115 THEN DO LOW925
     ELSE GO TO DECIDE1
DECIDE1:IF PICA76 GEQ 155 THEN DO SUMINVS01
   ELSE DO FINISHER

LOW925: ROUTINE
DO FINISHER
LOOP I BY QUOTAS BEGIN
 I=I*.925
      END
SOLVE COFFEE@QUOTA2
     TRACKLOW=V(TRACKLOW,.925)
IF PICA76 LEQ 115 THEN DO LOW900
       ELSE GO TO DECIDE1
DECIDE1:IF PICA76 GEQ 155 THEN DO SUMINVS01
      ELSE DO FINISHER

LOW900: ROUTINE
DO FINISHER
  LOOP I BY QUOTAS BEGIN
    I=I*.9
       END
SOLVE COFFEE@QUOTA2
     TRACKLOW=V(TRACKLOW,.9)
IF PICA76 LEQ 115 THEN &&
DISPLAY /,"QUOTA CUTS ARE INSUFFICIENT TO MOVE PRICE INTO ICA RANGE",
/
ELSE GO TO DECIDE1

DECIDE1:IF PICA76 GEQ 155 THEN DO SUMINVS01
        ELSE DO FINISHER

DOSUMS: ROUTINE
LOOP I BY NLAREAS BEGIN
XSUM@!I=SUM(QINV!I)
SUM@!I=SERIES(XSUM@!I)
END

NEWQINV: ROUTINE
QINVBRA=SUM@BRA
QINVCOL=SUM@COL
QINVNAM=SUM@NAM
QINVSAMOTHER=SUM@SAMOTHER
QINVAFR=SUM@AFR
QINVASIA&OCE=SUM@ASIA&OCE

SUMINVS01: ROUTINE
DO DOSUMS
SUM@BRA=SUM@BRA*.9
SUM@COL=SUM@COL*.9
SUM@NAM=SUM@NAM*.9
SUM@SAMOTHER=SUM@SAMOTHER*.9
SUM@AFR=SUM@AFR*.9
SUM@ASIA&OCE=SUM@ASIA&OCE*.9
SUM@ALL=(SUM@BRA+SUM@COL+SUM@NAM+SUM@SAMOTHER+SUM@AFR+SUM@ASIA&OCE)
IF SUM@ALL GEQ 0 THEN DO HIGH01
ELSE DISPLAY /,"QUOTA STOCKS REACH 0",/
DO FINISHER
```

```
HIGH01: ROUTINE
 1  >COFFEE@QUOTA2=COFFEE@QUOTA2 EXCEPT NL(EXBRAQEQ,EXCOLQEQ,EXNAMQEQ,&&
 2  >EXSAMOTHERQEQ,EXAFRQEQ,EXASIA&OCEQEQ,QINVBRAEQ,QINVCOLEQ,QINVNAMEQ,
    &&
 2.5>QINVSAMOTHEREQ,QINVAFREQ,QINVASIA&OCEEQ)
 3  >COFFEE@QUOTA2=COFFEE@QUOTA2 CONCAT NL(EXBRAEQH01,EXCOLEQH01,
 4  >             EXNAMEQH01,EXSAMOTHEREQH01,EXAFREQH01,
 5  >             EXASIA&OCEEQH01)
 6  >COFFEE@QUOTA2=ORDER(COFFEE@QUOTA2)
 7  >SOLVE COFFEE@QUOTA2
 8  >TRACKHIGH=V(.1)
 9  >IF PICA76 GEQ 155 THEN DO SUMINVS03
10  >        ELSE DO DECIDE2

SUMINVS03: ROUTINE
 1>SUM@BRA=SUM@BRA*.7
 2>SUM@COL=SUM@COL*.7
 3>SUM@NAM=SUM@NAM*.7
 4>SUM@SAMOTHER=SUM@SAMOTHER*.7
 5>SUM@AFR=SUM@AFR*.7
 6>SUM@ASIA&OCE=SUM@ASIA&OCE*.7
 7>SUM@ALL=(SUM@BRA+SUM@COL+SUM@NAM+SUM@SAMOTHER+SUM@AFR+SUM@ASIA&OCE)
 8>IF SUM@ALL GEQ 0 THEN DO HIGH03
 9>ELSE DISPLAY /,"QUOTA STOCKS REACH 0",/
10>DO FINISHER

HIGH03: ROUTINE
 1>COFFEE@QUOTA2=COFFEE@QUOTA2 EXCEPT NL(EXBRAEQH01,EXCOLEQH01,&&
 2>EXNAMEQH01,EXSAMOTHEREQH01,EXAFREQH01,EXASIA&OCEEQH01)
 3>COFFEE@QUOTA2=COFFEE@QUOTA2 CONCAT NL(EXBRAEQH03,EXCOLEQH03,
 4>              EXNAMEQH03,EXSAMOTHEREQH03,EXAFREQH03,
 5>              EXASIA&OCEEQH03)
 6>COFFEE@QUOTA2=ORDER(COFFEE@QUOTA2)
 7>SOLVE COFFEE@QUOTA2
 8>TRACKHIGH=V(TRACKHIGH,.3)
 9>IF PICA76 GEQ 155 THEN DO SUMINVS05
10>        ELSE DO DECIDE2

SUMINVS05: ROUTINE
 1>SUM@BRA=SUM@BRA*.5
 2>SUM@COL=SUM@COL*.5
 3>SUM@NAM=SUM@NAM*.5
 4>SUM@SAMOTHER=SUM@SAMOTHER*.5
 5>SUM@AFR=SUM@AFR*.5
 6>SUM@ASIA&OCE=SUM@ASIA&OCE*.5
 7>SUM@ALL=(SUM@BRA+SUM@COL+SUM@NAM+SUM@SAMOTHER+SUM@AFR+SUM@ASIA&OCE)
 8>IF SUM@ALL GEQ 0 THEN DO HIGH05
 9>ELSE DISPLAY/,"QUOTA STOCKS REACH 0",/
10>DO FINISHER

HIGH05: ROUTINE
1>COFFEE@QUOTA2=COFFEE@QUOTA2 EXCEPT NL(EXBRAEQH03,EXCOLEQH03,&&
2>EXNAMEQH03,EXSAMOTHEREQH03,EXAFREQH03,EXASIA&OCEEQH03)
3>COFFEE@QUOTA2=COFFEE@QUOTA2 CONCAT NL(EXBRAEQH05,EXCOLEQH05,
4>             EXNAMEQH05,EXSAMOTHEREQH05,EXAFREQH05,EXASIA&OCEEQH05)
5>COFFEE@QUOTA2=ORDER(COFFEE@QUOTA2)
6>SOLVE COFFEE@QUOTA2
7>TRACKHIGH=V(TRACKHIGH,.5)
8>IF PICA76 GEQ 155 THEN DO SUMINVS07
9>      ELSE DO DECIDE2

SUMINVS07: ROUTINE
 1>SUM@BRA=SUM@BRA*.3
 2>SUM@COL=SUM@COL*.3
 3>SUM@NAM=SUM@NAM*.3
 4>SUM@SAMOTHER=SUM@SAMOTHER*.3
 5>SUM@AFR=SUM@AFR*.3
 6>SUM@ASIA&OCE=SUM@ASIA&OCE*.3
 7>SUM@ALL=(SUM@BRA+SUM@NAM+SUM@COL+SUM@SAMOTHER+SUM@AFR+SUM@ASIA&OCE)
 8>IF SUM@ALL GEQ 0 THEN DO HIGH07
 9>ELSE DISPLAY /,"QUOTA STOCKS REACH 0",/
10>DO FINISHER
```

```
HIGH07: ROUTINE
 1>COFFEE@QUOTA2=COFFEE@QUOTA2 EXCEPT NL(EXBRAEQH05,EXCOLEQH05,&&
 2>EXNAMEQH05,EXSAMOTHEREQH05,EXAFREQH05,EXASIA&OCEEQH05)
 3>COFFEE@QUOTA2=COFFEE@QUOTA2 CONCAT NL(EXBRAEQH07,EXCOLEQH07,
 4>                EXNAMEQH07,EXSAMOTHEREQH07,EXAFREQH07,
 5>                EXASIA&OCEEQH07)
 6>COFFEE@QUOTA2=ORDER(COFFEE@QUOTA2)
 7>SOLVE COFFEE@QUOTA2
 8>TRACKHIGH=V(TRACKHIGH,.7)
 9>IF PICA76 GEQ 155 THEN DO SUMINVS09
10>        ELSE DO DECIDE2

SUMINVS09: ROUTINE
 1>SUM@BRA=SUM@BRA*.001
 2>SUM@COL=SUM@COL*.001
 3>SUM@NAM=SUM@NAM*.001
 4>SUM@SAMOTHER=SUM@SAMOTHER*.001
 5>SUM@AFR=SUM@AFR*.001
 6>SUM@ASIA&OCE=SUM@ASIA&OCE*.001
 7>SUM@ALL=(SUM@BRA+SUM@COL+SUM@NAM+SUM@SAMOTHER+SUM@AFR+SUM@ASIA&OCE)
 8>IF SUM@ALL GEQ 100 THEN DO HIGH09
 9>ELSE PRINT SUM@ALL
10>
16>DO FINISHER

HIGH09: ROUTINE
 1>COFFEE@QUOTA2=COFFEE@QUOTA2 EXCEPT NL(EXBRAEQH07,EXCOLEQH07,&&
 2>EXNAMEQH07,EXSAMOTHEREQH07,EXAFREQH07,EXASIA&OCEEQH07)
 3>COFFEE@QUOTA2=COFFEE@QUOTA2 CONCAT NL(EXBRAEQH09,EXCOLEQH09,
 4>                EXNAMEQH09,EXSAMOTHEREQH09,EXAFREQH09,
 5>                EXASIA&OCEEQH09)
 6>COFFEE@QUOTA2=ORDER(COFFEE@QUOTA2)
 7>SOLVE COFFEE@QUOTA2
 8>TRACKHIGH=V(TRACKHIGH,.9)
 9>IF PICA76 GEQ 155 THEN &&
10>DISPLAY /,"QUOTA STOCKS EXHAUSTED BUT PRICE STILL NOT IN ICA RANGE",/
11>PRINT SUM@ALL
12>DO FINISHER
19>

?PRINT EXBRAEQH01,EXBRAEQH03,EXBRAEQH05,EXBRAEQH07,EXBRAEQH09

EXBRAEQH01: EQUATION
1>EXBRA=IF (QBRA-CONBRA-(IEBRA-IEBRA\1)) LEQ QEXBRA THEN EXBRA ELSE &&
2>QEXBRA+(.1*SUM@BRA)

EXBRAEQH03: EQUATION
1>EXBRA=IF (QBRA-CONBRA-(IEBRA-IEBRA\1)) LEQ QEXBRA THEN EXBRA ELSE &&
2>QEXBRA+(.3*SUM@BRA)

EXBRAEQH05: EQUATION
1>EXBRA=IF (QBRA-CONBRA-(IEBRA-IEBRA\1)) LEQ QEXBRA THEN EXBRA ELSE &&
2>QEXBRA+(.5*SUM@BRA)

EXBRAEQH07: EQUATION
1>EXBRA=IF (QBRA-CONBRA-(IEBRA-IEBRA\1)) LEQ QEXBRA THEN EXBRA ELSE &&
2>QEXBRA+(.7*SUM@BRA)

EXBRAEQH09: EQUATION
1>EXBRA=IF (QBRA-CONBRA-(IEBRA-IEBRA\1)) LEQ QEXBRA THEN EXBRA ELSE &&
2>QEXBRA+(.999*SUM@BRA)
```

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